CENTER for BIOLOGICAL DIVERSITY Because life is good.

December 16, 2015

via electronic mail and U.S. mail to:

Department of Conservation
ATTN: Aquifer Exemption
801 K Street, MS 24-02
Sacramento, CA 95814
comments@conservation.ca.gov

Re: Freeport-McMoRan Oil & Gas, LLC, Arroyo Grande Oil Field Aquifer Exemption--Dollie Sands, Pismo Formation

To Whom It May Concern,

The Center for Biological Diversity ("the Center") submits this second round of comments in opposition to the recommendation of the Department of Conservation, Division of Oil, Gas and Geothermal Resources ("DOGGR") to exempt the Arroyo Grande Oil Field ("AGOF") aquifer in order to allow Freeport-McMoRan ("FMOG") to inject oil wastewater into the aquifer. Under federal law, the US EPA may not approve an aquifer exemption if it is currently or could be used as a source of drinking water.[1] Under state law, DOGGR and the State Water Resources Control Board ("State Water Board") cannot exempt an aquifer that will affect any water used for "beneficial" uses—defined broadly—or is not isolated from other groundwater.[2] The Center's first round comments, incorporated by reference, showed that FMOG's application failed to meet the legal requirements for exempting an aquifer under both federal and state law for the following reasons.

- The historic drought has prompted mandatory water restrictions; the drilling of new water wells deeper and tapping into previously unused aquifers; and the serious consideration

[1] 40 C.F.R. § 146.4.
[2] Cal. Pub. Res. Code §§ 3131(a)(2), (3).

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of using alternative water purification technologies.[3] For these reasons, the state and federal government must take a hard look at whether they are truly willing to sacrifice water supplies with potential beneficial uses (such as, here, where aquifer water is sent to Pismo Creek) or that could affect or be used as domestic water supplies, for the convenience of the oil industry, in violation of state and federal law.

- The proposed exemption is tied to a massive expansion of oil operations at AGOF, which will affect pressure, groundwater flow, and zonal isolation, in addition to the potential for increasing seismic risk and subsidence. These operations will also vastly increase the waste water produced at the site.[4] DOGGR, the State Water Board, and US EPA cannot approve the exemption until a full analysis of the hydrology under these conditions has been performed to demonstrate hydraulic isolation, including isolation from current and potential sources of drinking water. It has not been performed here.
- Similarly, FMOG has not presented a detailed analysis of the toxicity of the water it uses for steam injection or waste water disposal; nor has it provided an analysis of the effects its gas injection has on the pressure (hence, groundwater flow) of the AGOF.
- The burden is on FMOG to prove that the aquifer is not currently used for drinking water, and that it will not affect drinking water or beneficial use water; the presumption is in favor of protecting aquifers.[5] Even without the planned expansion, FMOG failed to provide adequate information to prove this.

Nothing in the new documentation provided by DOGGR does anything to change the fact that FMOG has not provided the necessary information to prove the aquifer is isolated and/or that injection of drilling wastewater will not affect beneficial use or drinking water. What is

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[3] Center for Biological Diversity, Comments on the Arroyo Grande Oil Field Aquifer Exemption Application (September 21, 2015) ("CBD, Sept. 21 Aquifer Exemption Comments"), pp. 3-4; Center for Biological Diversity, Comments to San Luis Obispo Planning Commission re: Freeport-McMoRan Oil & Gas, LLC, Arroyo Grande Oil Field, Application to Extend Phase IV CUP # D010386D (October 21, 2015) ("CBD, Oct. 21, 2015 CUP Phase IV Extension Comments"), pp. 4-5; Center for Biological Diversity, Appeal from Planning Commission Decision on November 12, 2015 to San Luis Obispo County Supervisors File Number DRC20150002 (November 25, 2015) and attached letter from Matt Hagemann (together, "CBD, Nov. 25, 2015 Appeal"), pp. 4. All of these documents are attached and incorporated in their entirety herein.

[4] CBD, Sept. 21 Aquifer Exemption Comments, pp. 9-12.

[5] 40 C.F.R. § 144.12; 40 C.F.R. §§ 144.7(a), (b); *United States v. King*, 660 F.3d 1071, 1079 (9th Cir. 2011). *See* CBD, Sept. 21 Aquifer Exemption Comments, pp. 5-8, 14.

more, despite repeated requests from the nearby residents and the Center, and despite an order from the Central Coast Regional Water Quality Control Board ("Regional Board"), FMOG has consistently refused to provide critical information, such as accurate nearby water well locations, depth and samples, or a numerical groundwater flow model,[6] which are critical to demonstrating that this aquifer meets the criteria set forth in state and federal law. For these reasons and the reasons set forth below, DOGGR and the US EPA must deny the exemption request. In particular, the new information provided raises only more concerns about the integrity of the "boundaries" of the aquifer, the lack of data about nearby wells, and the use of antiquated criteria to legitimize currently illegal injection activity. Additionally, data from the California Air Resources Board demonstrates that this oil field is extremely water and carbon intensive to produce, which raises policy concerns about the utility of sacrificing California's groundwater to an increasingly inefficient oil field during a time when water is at a premium and the climate is at risk.

FMOG's Hydraulic Analysis Remains Woefully Inadequate; It Does Not Demonstrate Isolation from Drinking Water or Beneficial Use Water.

The documentation supporting FMOG's application reveals its best guess as to whether the proposed exemption area is isolated from drinking water and other potential water supplies. Its best guess, however, is not good enough to overcome the presumption in favor of protecting groundwater, especially in a time of extreme drought. Additionally, it is not necessary for the public to cross its fingers and rely on a "best guess"; FMOG could, in fact, conduct the proper tests and evaluations of the aquifer. For instance, FMOG should provide, and the agencies should require, a numerical groundwater model to map and analyze groundwater flow under various

[6] *See, e.g.*, CBD, Sept. 21 Aquifer Exemption Comments, pp. 12-20; Center for Biological Diversity, Comments to San Luis Obispo Planning Commission re: Freeport-McMoRan Oil & Gas, LLC, Arroyo Grande Oil Field, Application to Extend Phase IV CUP # D010386D--Supplemental Information (Nov. 11, 2015), pp. 3-4, and attached letter from Matt Hagemann (together, "CBD Nov. 11, 2105 Supplemental CUP Phase IV Extension Comments," incorporated in its entirety); CBD, November 25, 2015 Appeal, pp. 5-8; Central Coast Regional Water Quality Control Board, Order Pursuant to California Water Code section 13267 ("13267 Order") (May 14, 2015); FMOG's inadequate and incomplete response to this order can be found at http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T10000006979. *See also*, Natural Resources Defense Council, *Aquifer Exemption Comments*, September 21, 2015 ("NRDC Comments,") p. 8 (noting that application fails to adequately identify groundwater flow directions or how pumping activities affect the hydraulic gradient, and that the application fails to provide the necessary well data for nearby water supply wells, including depth, status, and use of the wells).

pumping and injection conditions. FMOG should provide, and the agencies should require, detailed information about water wells within one mile of the proposed exempted area. Instead, FMOG and the agencies rely on vague, anecdotal, and inferred evidence to assert that the aquifer is not hydraulically connected to nearby water wells, and that the aquifer's boundaries are nearly impermeable.

The federal regulations require that FMOG demonstrate that the aquifer does not or cannot now or in the future be used as a source of drinking water because it is: (1) hydrocarbon producing or contains hydrocarbons that are commercially producible, (2) it is situated at a location or depth that makes it economically or technologically impractical to use for drinking water, or (3) it is so contaminated that it would be economically or technologically impractical to drink it.[7] Alternatively, an aquifer can receive an exemption if (4) the TDS is over 3,000 and it is not reasonably expected to supply a public water system.[8] Here, DOGGR and the US EPA have already stated that it is not hydrocarbon bearing, so (1) does not apply, and it is under 3,000 mg/L TDS, so (4) cannot apply. In June 2015, DOGGR wrote in a letter to FMOG:

> The reported injection zone water (receiving water) is less than 3,000 mg/L TDS, and although much of the area that is request for exemption is hydrocarbon producing, there are portions of the requested exemption area that are no longer productive. USEPA staff has recently stated verbally that, unless the injection is for enhanced oil recovery (EOR) purposes, an aquifer exemption for aquifers with less than 3,000 mg/L TDS is very difficult to justify. To support an aquifer exemption proposal in these areas, strong documentation is needed to indicate: 1) the proposed aquifer exemption area is situated at a depth or location which makes recover of water for drinking water purposes economically or technologically impractical and/or 2) it is so contaminated that it would be economically or technological impractical to render that water fit for human consumption. In addition, documentation is needed to indicate that the proposed exempted portion of the formation is sufficiently isolated such that injection would not pose a threat to the portion of the aquifer with existing beneficial uses.[9]

Thus, FMOG cannot rely on the "hydrocarbon-bearing" or "over 3,000 mg/L TDS" criteria to exempt its aquifer, and must instead assert that the aquifer is not and cannot be used for drinking

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[7] 40 C.F.R. §§ 146.4(a), (b).
[8] 40 C.F.R. §§ 146.4(c).
[9] Letter from Patricia Abel, District Deputy, DOGGR, to Kenneth R. Bork, Agent, Freeport-McMoRan Oil & Gas, LLC Re: Arroyo Grande Oil Field, Aquifer Exemption, Dollie Zone of Pismo Fm (June 8, 2015) ("DOGGR, June 8, 2015 Letter"), p. 3.

water, and that it will not threaten nearby groundwater with beneficial uses. FMOG cannot meet these criteria.

First, FMOG cannot show that the water is sufficiently isolated so as not to affect beneficial use groundwater. For example, the Statement of Basis relies on the fault that forms the northern boundary to restrict water flow, but provides no supporting pump tests or aquifer tests. Given that there are water wells directly adjacent to aquifer exemption boundary created by the fault, these tests, in addition to a numerical groundwater model, are critical to protecting these wells' water.[10] The Statement of Basis also asserts that the Miguelito Member forms a layer of protection from drinking water wells.[11] However, the Miguelito Member forms the bottom of the alleged synclinal bowl that underlies the Edna Member. It cannot, therefore, serve as a barrier between the wells in the exempt area and water wells completed in the Edna Member.[12] In fact, there are six wells that are themselves completed in the Miguelito Member, suggesting it is an aquifer rather than an aquitard.[13] Furthermore, FMOG and DOGGR place great emphasis on the tar seal providing a hydraulic barrier that would prevent drinking water from being contaminated by FMOG's injection into this aquifer. The permeability and even existence of the tar seal at the locations depicted in cross section B to B', however, is inferred at best,[14] and the public should not be forced to rely on FMOG's and the agencies' sincerest hope that these inferences are correct.[15]

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[10] Matt Hagemann, PG, C. Hg., Comments on the Arroyo Grande Aquifer Exemption Application (Dec. 14, 2015) ("Hagemann, Dec. 14, 2015 Aquifer Exemption Comments," Attachment A), pp. 3 (map) & 4.
[11] Statement of Basis, p. 6.
[12] Hagemann, Dec. 14, 2015 Aquifer Exemption Comments, p. 4.
[13] *Ibid.*; NRDC Comments, p. 16, further describing the discontinuities in the Miguelito Member.
[14] FMOG, Aquifer Exemption Application, Appendix A7a2; Hagemann, Dec. 14, 2015 Aquifer Exemption Comments, p. 5. *See also* NRDC Comments, p. 17 ("Both publications from DOGGR [1944 and 1958 showing the location and distribution of tar sands] occur in discrete and discontinuous deposits that outcrop at various locations throughout the field....").
[15] Mr. Hagemann notes that in addition to concerns that water from the exempted aquifer will pollute nearby wells, there are real, unanswered concerns about the potential for the dewatering project to draw adjacent water inward: "the inward gradient may induce flow of groundwater across the fault boundary and across any hydraulic boundary that is represented by the tar sands. . . in light of the amount of water that is removed from the oil field, a condition known as dewatering. Since approval of the Project, aquifer dewatering has been actively pursued by the applicant. . . . The dewatering lowers hydraulic pressure and creates a 'sink,' according to the applicant. The impact of this pressure sink on inducing flow from adjacent drinking water resources and across the exemption boundaries as not been evaluated and should be tested using aquifer tests and numeric model." Hagemann, Dec. 14, 2015 Aquifer Exemption Comments, pp. 4-5.

Second, FMOG cannot demonstrate that the water is not or cannot be used for domestic water. Indeed, at least 24 wells are known to have been completed in the Edna Member of the Pismo Formation, the same geologic unit that is proposed for exemption.[16] Many of these are just "outside" the inferred tar seal.[17] The Statement of Basis notes that none of the water supply wells are located in the Dollie Sands,[18] but this assertion is misleading and a red herring; the Dollie Sands are part of the Edna Member and are not a recognized separate geologic unit or formation.[19] Indeed, despite the fact that at least 24 wells draw from the same water bearing unit at similar depths, FMOG has not presented any geologic cross sections that would depict the relationship of drinking water wells to the injection wells or production wells. While the scale of the aerial map provided in the "new" information supporting the exemption request is too large to precisely identify the location of nearby water wells, it is clear that water wells within several hundred feet of the proposed exemption boundary draw water from the Edna Member at similar depths as that which injection occurs.[20] At the very least, therefore, FMOG *must* provide *specific* latitudinal and longitudinal points for the wells, their depths, and confirmation of the vertical interval into which the wells have been completed[21] before DOGGR and US EPA can act on its request.

Yet, despite the proximity of at least 105 drinking water wells within one mile of the Project, the uncertainty of the ability of potential barriers to contain oil field water, and the fact that dozens of water wells have been built in the Edna Member, and despite repeated requests from the Center and AGOF's neighbors for FMOG to present *detailed* analyses of nearby water wells, FMOG has not provided this information. FMOG's lack of cooperation and data

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[16] Hagemann, Dec. 14, 2015 Aquifer Exemption Comments, pp. 2-4 (discussing 24 water wells within a one-mile radius that are completed in the Edna Member, and noting that "[t]he Statement of Basis makes an even greater omissions by failing to state that four drinking water wells in Section 32 and seven wells in Section 5, the areas that contain wells nearest to the exemption area, are completed in the Edna Member of the Pismo Formation, the same geologic member and formation that is the subject of the Application.") There are likely more wells completed in this shallow formation, but FMOG has found well completion data for only about half of the 105 wells within one mile of the oil field. (*Id.* at 2.)

[17] Hagemann, Dec. 14, 2015 Aquifer Exemption Comments, p. 3 (map), *see also* Attachment B – cross section showing water well location in proximity to aquifer exemption boundary prepared by registered Professional Geologist Rob Hesse.

[18] Statement of Basis, p. 3.

[19] *Id.* at 4. *See also* NRDC Comments, p. 10, referring to the unit as the "Edna/Dollie Sands Member of the Pismo Formation."

[20] Hagemann, Dec. 14, 2015 Aquifer Exemption Comments, pp. 2-3.

[21] *Id.* at 3.

production is particularly egregious in light of the fact that both DOGGR and the Regional Board *themselves* have required this information, but for some reason have not enforced their requests. As recently as June 2015, DOGGR wrote to FMOG asking for more information to support an exemption:

> Freeport-McMoRan has indicated that some water from the upper Pismo formation is currently being used, which strongly indicates that water from the Pismo has current beneficial use. Freeport-McMoRan needs to confirm that accuracy of the statement that there are no beneficial uses of water, as well as identify all wells and their uses within a one-mile radius of the proposed aquifer exemption.[22]

Meanwhile, in May 2015, the Regional Board issued an order pursuant to California Water Code section 13267 requiring FMOG to submit "technical reports containing information about . . . nearby water supply wells, including domestic wells within a one-mile radius of the injection wells."[23] This information was to include a "list and location map of all water supply wells, including domestic wells, within one mile of each injection well subject to this Order," and:

> Information for each identified water supply well, including the well owner name and contact information; type of well (i.e., domestic, irrigation, industrial, etc.); whether any of the water is used for domestic purposes; status (i.e., active, idle, etc.); well construction, including screened interval depths; borehole geophysical logs; and all analytical results for any water sample(s) collected from each water supply well.[24]

A review of Geotracker as of December 15, 2015 shows that FMOG has not submitted this required information,[25] and this information does not appear anywhere in the documentation provided on DOGGR's website to support the exemption.[26] It is important to have this information prior to making a decision on the exemption, in part because FMOG uses solvents and acids to clean and maintain injections wells that must not be allowed to contaminate drinking water.[27]

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[22] DOGGR, June 8, 2015 Letter, p. 3.
[23] 13267 Order, p. 3, para. f.
[24] *Id.* at 3.
[25] Documents submitted by FMOG in response to the 13267 Order can be found on Geotracker, *available at* http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T10000006979.
[26] http://www.conservation.ca.gov/dog/Pages/Aquifer_Exemptions.aspx.
[27] Arroyo Grande Oil Field, Injection Project Review (Oct. 22, 2014), Orcutt, CA (power point presentation), p. 18.

In addition to the water well data already required by the Regional Board, the studies and data FMOG must conduct and provide to demonstrate the safety of an exemption are not particularly exceptional or rare, and there is no reason the agencies should not require them in order to protect Californians. For example, as the Natural Resources Defense Council ("NRDC") stated in its September 21, 2015 Aquifer Exemption Comments, "[i]nformation must be collected that demonstrates water level data, relevant geologic features, and discharge rates for steady-state and non-steady state aquifer responses; to ultimately identify any potential *current* communication to the aquifer exemption boundary through a radius of influence induced by a discharge promoted cone of depression."[28] In the attached comments by certified hydrogeologist Matt Hagemann, Mr. Hagemann similarly asserts that FMOG must submit aquifer tests and numerical groundwater models and simulations to evaluate if the oil field is isolated from groundwater used for drinking water.[29] Mr. Hagemann notes that "[n]umerical (computer-based) models of groundwater systems are commonly used to simulate the flow of groundwater, including the response of water levels across aquifer boundaries under conditions of injection and pumping. Aquifer tests, where water is removed or added and where response in adjacent wells is measured, are also critical to test the concept of hydraulic barriers."[30] NRDC further points to the value of providing "permeability or porosity maps or cross-sections documenting the alleged loss in permeability it claims will provide confinement on the east and west sides of the field."[31]

Thus, there are available tests and models that can effectively determine or demonstrate FMOG's assertions of aquifer isolation. It is unclear why, then, the agencies are content to rely on guesstimates and inferences rather than require FMOG to submit fundamental information necessary to ensure the safety of those who live near the oil field and of California's scarce water resources.

DOGGR and US EPA Cannot Use Antiquated Criteria to Legitimize Illegal Injection

[28] NRDC Comments, p. 8.
[29] Hagemann, December 14, 2015 Aquifer Exemption Comments, p. 5.
[30] *Ibid.*
[31] NRDC Comments, p. 16.

Even if the documentation did support an exemption under the federal criteria[32] (which it does not), the criteria itself is antiquated, and cannot be the only criteria used to determine whether to allow FMOG to use California's aquifers to inject oil field waste water and steam. The historic drought has fundamentally changed the way Californians use water. It has prompted mandatory water restrictions, new wells that are deeper and that tap into previously unused aquifers, and the serious consideration of alternative water purification technologies. As other comments noted earlier, these regulations are more than thirty years old, and water treatment technology has improved drastically since then, especially as water demand from previously unused groundwater sources has increased due to the drought.[33] For instance, just this week, the Carlsbad desalination plant went online.[34] Even at the time they were adopted, the aquifer exemption criteria were an accommodation to the oil industry rather than regulations based on or rooted in science and technology.[35] DOGGR and US EPA must instead apply 21st-century standards and to 21st-century needs when analyzing whether it is truly appropriate to exempt this aquifer from the protections of the Safe Drinking Water Act.

The Center further objects to using this antiquated criteria to legitimize illegal injection into protected aquifers at the AGOF. There are at least eight wells operating at the AGOF permitted to inject into groundwater that is currently protected under the SDWA.[36] DOGGR has passed "emergency" regulations that purportedly allow injection wells such as those at the AGOF to continue to operate until February 2017, by which time they must either receive an exemption or cease operation.[37] DOGGR's own failure to oversee its underground injection

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[32] 40 C.F.R. §§ 145.4(a)-(c).

[33] NRDC Comments, p. 1; John Noel, *Aquifer Exemptions: A First-Ever Look at the Regulatory Program That Writes off Drinking Water Resources for Oil, Gas, and Uranium Profits* (Clean Water Action/Clean Water Fund, Jan. 2015) ("Noel"), p. 6, *available at* http://www.cleanwateraction.org/files/publications/Aquifer%20Exemptions%20-%20Clean%20Water%20report%201.6.15.pdf

[34] *See, e.g.,* Bradley J. Fikes, "$1-Billion Desalinaton Plant, Hailed as Model for State, Opens in Carlsbad," *Los Angeles Times* (Dec. 14, 2015), *available at:* http://www.latimes.com/local/california/la-me-desalination-20151215-story.html.

[35] NRDC Comments, p. 1; Noel, p. 6.

[36] Steve Bohlen, State Oil & Gas Supervisor, DOGGR and Jonathan Bishop, Chief Deputy Director, State Water Resources Control Board, Letter to Michael Montgomery, US EPA, Region IX (October 15, 2015), *available at* ftp://ftp.consrv.ca.gov/pub/oil/UIC%20Files/20151015%20-%20Joint%20Letter%20to%20US%20EPA%20Cat%201%20Well%20Review%20Findings.pdf.

[37] Cal. Code Regs. tit. 14 § 1779.1(a).

program and prevent illegal injection[38] does not constitute an "emergency" in need of continued unlawful activity, however. An "emergency" is a situation that calls for immediate action to "avoid serious harm to the public peace, health, safety, or general welfare."[39] In contrast, here, DOGGR's "emergency" regulations increase, rather than stem, a public emergency by perpetuating ongoing contamination that threatens public health and general welfare. In fact, the SDWA expressly prohibits a state agency's promulgation of regulations that relieve it or other parties from the Act's requirements, stating, "no law or regulation" adopted or enforced by a state agency "shall relieve any person of any requirement otherwise applicable under" the SDWA.[40] DOGGR's attempt to "codify" illegal activity is wrong, and the US EPA must not reward DOGGR and FMOG for illegally injecting over 63 million gallons of waste water and steam into a protected aquifer[41] by suddenly sanctioning it pursuant to outdated criteria.

Even if US EPA intends to follow the "emergency" regulations, illegal injection at the AGOF must cease. As the US EPA itself noted, the aquifer is both below 3,000 TDS and is not entirely hydrocarbon producing.[42] Therefore, the earliest deadline set out in the regulations for illegal injection to cease must apply here: "If the portion of the aquifer is injection is approved is not a hydrocarbon producing zone and the groundwater has less than 3,000 TDS, then injection shall cease by October 15, 2015," rather than February 15, 2017.[43] As October 15, 2015 has passed, all illegal injection must stop immediately.

Finally, what is perhaps most disturbing about DOGGR's actions in remedying its failure to effectively administer the underground injection ("UIC") program is that during the time when DOGGR has supposedly been reviewing the *thousands* of wells it permitted to inject into protected aquifers and committing itself to more stringent injection regulation, DOGGR has been *continuing to issue permits for injection wells in nonexempt areas of the aquifer at the AGOF*. On November 16, 2012, DOGGR acknowledged that it had been aware since 2009 that its UIC program had failed to comply with state law and regulations, including failing to protect aquifers to the extent required by the US EPA.[44] It committed to fixing the program and reviewing the non-compliant wells. In the

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[38] For a description of this failure, *see e.g.,* CBD, Sept. 21 Aquifer Exemption Comments, pp. 2-3; CBD, Oct. 21, 2015 CUP Phase IV Extension Comments, pp. 6-7.
[39] Cal. Gov. Code § 11342.545.
[40] 42 U.S.C. § 300h-2(d). *See also* 42 U.S.C. § 300f (defining "person" to include state agencies).
[41] *See* NRDC Comments, p. 6, Table 2.
[42] DOGGR, June 8, 2015 Letter, p. 3.
[43] Cal. Code Regs. tit. 14 § 1779.1(a)(1).
[44] Letter from Tim Kustic, State Oil and Gas Supervisor, DOGGR to David Albright, Manager, Ground Water Office US EPA Region IX, Response to the US EPA June 2011 Review of California's UIC

meantime, DOGGR issued permits to drill or rework injection wells in the non-exempt portion of the AGOF aquifer.[45] The permits to rework the injection wells contained no condition making injection contingent on receipt of an aquifer exemption. There is simply no basis for DOGGR to continue on this path of allowing such injection to continue, or for the US EPA to condone DOGGR's actions in failing to protect California's precious groundwater by approving this exemption.

The AGOF is Exceedingly Energy and Water Intensive; the Exemption and Planned Expansion Will Frustrate the State's Climate and Water Goals

According to data collected by the California Air Resources Board ("CARB") for implementation of the Low Carbon Fuel Standard ("LCFS") in 2014, the water to oil ratio at the AGOF was 17.58.[46] This ratio is already higher than the state oil field average, which is 15.[47] According to FMOG's data in its aquifer exemption application,[48] current production from 221 active production wells is 29,750 bpd of water and 1,350 bpd of oil,[49] which provides a water to oil ratio of 22. Despite the addition of new injection wells and production wells, the efficiency of oil production at AGOF appears to be decreasing, requiring larger volumes of water to produce smaller amounts of oil. The decreasing efficiency of production means that the oil field's energy intensity and water usage is going to increase, as it takes ever larger amounts of steam to produce oil.

Program (Nov. 16, 2012) ("November 16, 2012 letter") and Attachment to November 16, 2012 letter: Response to the US EPA June 2011 Review of California's UIC Program, p. 1. *See also* Letter from David Albright, Manager, Ground Water Office, US EPA Region IX, to Elena Miller, State Oil and Gas Supervisor, DOGGR (July 18, 2011) ("July 18, 2011 letter").

[45] *See, e.g.,* Document titled "02806003 #2 of 2, pdf" (produced by DOGGR on Dec. 8, 2015, in response to a Public Records Request from the Center for Biological Diversity dated Nov. 2, 2015), pp. 19-24 (permits to drill injection wells, conditioned on receipt of an aquifer exemption, in 2014); pdf pp. 52, 53, 55, 60, 62 (permits to rework injection wells in non-exempt aquifer, not conditioned on receiving exemption, in 2013-2014).

[46] LCFS Crude Oil Lifecycle Assessment, California Air Resources Board, *available at* http://www.arb.ca.gov/fuels/lcfs/crude-oil/crude-oil.htm (OPGEE 1.1E).

[47] *Ibid.*

[48] Arroyo Grande Oilfield Edna Member Dollie Sands Pismo Formation Aquifer Exemption Application, DOGGR, ("FMOG, Aquifer Exemption Application"), *available at* ftp://ftp.consrv.ca.gov/pub/oil/Aquifer_Exemptions/County/San_Luis_Obispo/Arroyo_Grande_Oilfield/Dollie_Sands_Pismo_Formation/Arroyo%20Grande%20Oilfield%20Edna%20Member%20Dollie%20Sands%20Pismo%20Formation%20Aquifer%20Exemption%20Application%20Complete.pdf.

[49] *Id.* at 17.

This is of concern not only because of the water and energy intensity of the field in the context of California's severe drought, but also in the context of California's climate laws, including the LCFS and AB 32. Producing oil at the AGOF is extremely carbon intensive, with a carbon intensity ("CI") value (which includes producing and transporting the oil to be refined) of 27.81 compared to a state average of approximately 7.[50] It is one of the top ten most carbon-intensive fields in the state, with a higher CI value than dirty Canadian tar sands and far in excess of the CI of any imported oil to California, even taking into account the energy required in the transportation of oil from distant countries.[51] At the same time, the oil produced at AGOF has a low API (high specific gravity) of 14,[52] which means that it is an extra heavy oil, thus energy intensive to refine as well as to produce.

While the AGOF requires ever more steam and energy to produce less and less oil per well, FMOG intends to continue to expand and simultaneously dewater the oil field. This raises concerns about where the produced water will end up and the composition of that water, which are not addressed in the documentation supporting the aquifer exemption application. The Water Reclamation Facility ("WRF") at AGOF, for instance, was built to handle a throughput of only 20,000 bpd of water.[53] The AGOF, however, currently produces 29,750 bpd of water[54]—meaning that over 9,000 bpd of water per day must be disposed of without treatment at the WRF. This produced water contains high levels of chemicals and metals, including VOCs such as benzene, chromium, lead, and aluminum, among many others.[55] At the same time, according to FMOG's aquifer exemption documentation, the oil field currently discharges 18,050 barrels per day (bpd) of treated water into Pismo Creek, an amount equal to 64 percent of the water

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[50] Calculation of 2014 Crude Average CI Value, California Air Resources Board (June 16, 2015), *available at* http://www.arb.ca.gov/fuels/lcfs/crude-oil/2014_crude_average_ci_value_final.pdf.
[51] *Ibid.*
[52] Crude Oil Lifecycle Assessment, California Air Resources Board, *available at* http://www.arb.ca.gov/fuels/lcfs/crude-oil/crude-oil.htm (OPGEE 1.1E). According to this data, the state average is approximately 25.
[53] PXP Produced Water Reclamation Facility Subsequent Environmental Impact Report (2008), ch. 3, "Project Description," *available at* http://www.slocounty.ca.gov/Assets/PL/environmental/plains/Historical+Documents/2008+-+RO+Water+System+EIR/EIR+Documents/06+Chapter+3.0+Project+Description.pdf.
[54] FMOG, Aquifer Exemption Application, p. 17.
[55] FMOG, Response to CCRWQCB 13267 Order (August 21, 2015), Attachments A, 1-4 (Analyses of Groundwater from Each Injection Zone), *available at* http://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T10000006979.

produced by AGOF.[56] A NPDES discharge permit issued by the Regional Board for this facility, effective from February 1, 2014 through February 1, 2019, allows a maximum discharge of 0.84 million gallons per day (MGD) into Pismo Creek.[57] The current discharge, converted to gallons, is 0.758 MGD. For FMOG to comply with this water board permit, it can only discharge an additional 0.082 MGD into Pismo Creek. If FMOG expands operations at AGOF, it will produce more water. The expansion would require FMOG to find alternate means of disposing of produced water, either through additional injection, taking water offsite, a sump, or some other means. Presumably, the excess water that cannot go through the WRF or into Pismo Creek will be reinjected into the area of the aquifer that is currently the subject of this exemption application, but FMOG has not provided the exact details of this plan, such as the volume or composition of water that will be injected.

Conclusion

Even if DOGGR and US EPA apply the antiquated federal exemption criteria to this aquifer, it fails to meet state and federal requirements for exemption from the SDWA. FMOG has not shown that the aquifer is not now or could not in the future be used for drinking water or that it will not affect other beneficial use water. DOGGR and the US EPA cannot approve this exemption request, and all injection into the non-exempt aquifer must cease immediately. Furthermore, not only has the science and technology changed since the federal aquifer exemption regulations were put in place over thirty years ago, but also the regulatory environment has changed significantly. Since the 1980s, California has seen the passage and implementation of AB 32, the LCFS, and water restrictions due to a historic and severe drought. As a result of these and other changes in environmental law, science, and technology since the 1980s, the exemption criteria are no longer enough. The agencies must consider these advances of the last thirty years in determining whether to issue this exemption. In doing so and in order to protect Californians, the agencies must reject the aquifer exemption.

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[56] FMOG, Aquifer Exemption Application, p. 17. The 18,050 bpd discharged to Pismo Creek is 64 percent of AGOF's reported 29,750 bpd of produced water. *Ibid. See also* Hagemann Attachment, p. 6, to CBD, Nov. 25, 2015 Appeal.

[57] Central Coast Regional Water Quality Control Board, Draft Order R3-2013-0029, NPDES No. CA0050628 (December 5, 2013), pp. 4, 56-59, 64, 81, and 87.

Sincerely,

Maya Golden-Krasner
Climate Staff Attorney

LIST OF REFERENCES CITED AND ATTACHED

Center for Biological Diversity, Appeal from Planning Commission Decision on November 12, 2015 yo San Luis Obispo County Supervisors File Number DRC20150002 (November 25, 2015) and attached letter from Matt Hagemann

Abel, Patricia, District Deputy, DOGGR, letter to Kenneth R. Bork, Agent, Freeport-McMoRan Oil & Gas, LLC Re: Arroyo Grande Oil Field, Aquifer Exemption, Dollie Zone of Pismo Fm (June 8, 2015)

Albright, David, Manager, Ground Water Office, US EPA Region IX, letter to Elena Miller, State Oil and Gas Supervisor, DOGGR (July 18, 2011)

Bohlen, Steve, State Oil & Gas Supervisor, DOGGR and Jonathan Bishop, Chief Deputy Director, State Water Resources Control Board, Letter to Michael Montgomery, US EPA, Region IX (October 15, 2015)

Center for Biological Diversity, Comments on the Arroyo Grande Oil Field Aquifer Exemption Application (September 21, 2015)

Center for Biological Diversity, Comments to San Luis Obispo Planning Commission re: Freeport-McMoRan Oil & Gas, LLC, Arroyo Grande Oil Field, Application to Extend Phase IV CUP # D010386D (October 21, 2015)

Center for Biological Diversity, Comments to San Luis Obispo Planning Commission re: Freeport-McMoRan Oil & Gas, LLC, Arroyo Grande Oil Field, Application to Extend Phase IV CUP # D010386D--Supplemental Information (Nov. 11, 2015) and attached letter from Matt Hagemann

Central Coast Regional Water Quality Control Board, Order Pursuant to California Water Code section 13267 (May 14, 2015)

Central Coast Regional Water Quality Control Board, Draft Order R3-2013-0029, NPDES No. CA0050628 (December 5, 2013)

Department of Conservation (DOGGR),"02806003 #2 of 2, pdf" (produced by DOGGR on Dec. 8, 2015, in response to a Public Records Request from the Center for Biological Diversity dated Nov. 2, 2015)

DOGGR Response to the US EPA June 2011 Review of California's UIC Program

Freeport MacMoRan Oil and Gas, Arroyo Grande Oil Field, Injection Project Review (Oct. 22, 2014), Orcutt, CA (power point presentation)

Hagemann, Matt, PG, C. Hg., Comments on the Arroyo Grande Aquifer Exemption Application (December 14, 2015)

Kustic, Tim, State Oil and Gas Supervisor, DOGGR letter to David Albright, Manager, Ground Water Office US EPA Region IX, Response to the US EPA June 2011 Review of California's UIC Program (Nov. 16, 2012)

Natural Resources Defense Council, Aquifer Exemption Comments (Sept. 21, 2015)

Attachment A

Center for Biological Diversity comments on
Arroyo Grande Oil Field
Supplement to Aquifer Exemption Application

SWAPE Technical Consultation, Data Analysis and Litigation Support for the Environment

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December 14, 2015

Maya Golden-Krasner
Center for Biological Diversity
1212 Broadway, Suite 800
Oakland, CA 94612

Subject: Comments on the Arroyo Grande Aquifer Exemption Application

Dear Ms. Golden-Krasner:

I have reviewed the December 2, 2015 Arroyo Grande Aquifer Statement of Basis prepared by the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) and the State Water Resources Control Board and the Central Coast Regional Water Quality Control Board. I have also reviewed the 2015 Arroyo Grande Oilfield Aquifer Exemption Application prepared by the applicant, Freeport-McMoRan. The impacts to groundwater and drinking water resources have been the focus of my reviews of these materials.

I am licensed as a Professional Geologist and a Certified Hydrogeologist in California. My professional career spans over 25 years, including nine years with U.S. EPA Region 9. At the U.S. EPA, I was a geologist in the Groundwater Protection Section which included the regional branch of the Underground Injection Control Program. I also was responsible for the designation of two Sole Source Aquifers under provisions of the Safe Drinking Water Act and implementation of the Wellhead Protection Program. At the U.S. EPA I also held the position of Senior Science Policy Advisor. I am a partner in the consulting firm I helped to found 12 years ago.

Impacts from oil company operations on water resources has been the subject of recent public scrutiny. The California program which allows injection of produced water and well stimulation fluids into aquifers that are sources of drinking water has "serious deficiencies" according to the U.S. EPA.[1] The U.S. EPA is the process of determining if DOGGR's program meets regulatory requirements for the Class II Oil and Gas Underground Injection Program. An underlying foundation to the Class II Program is that injection of oilfield wastewater into aquifers is not allowed unless the groundwater has been exempted as a source of underground drinking water. Some of the injection of fluids into the Arroyo Grande oil field has been occurring into a non-exempt aquifer, necessitating Freeport-McMoRan to apply to expand

[1] ftp://ftp.consrv.ca.gov/pub/oil/UIC%20Files/CA%20Class%20II%20UIC%20letter%20December%2022%202014.docx.pdf , p. 3

its existing aquifer exemption for the Dollie Sands, a stratigraphic unit within the Edna Member of the Pismo Formation.

For DOGGR, the Water Board, and the public to adequately evaluate the Application, fundamental information is needed, including accurate information on where drinking water wells are located and how they will respond to the withdrawal and injection of fluids in the area of exemption. The need for accurate information on the drinking water wells is critical because of their immediate proximity to the exemption area and their completion within the same vertical geologic interval.

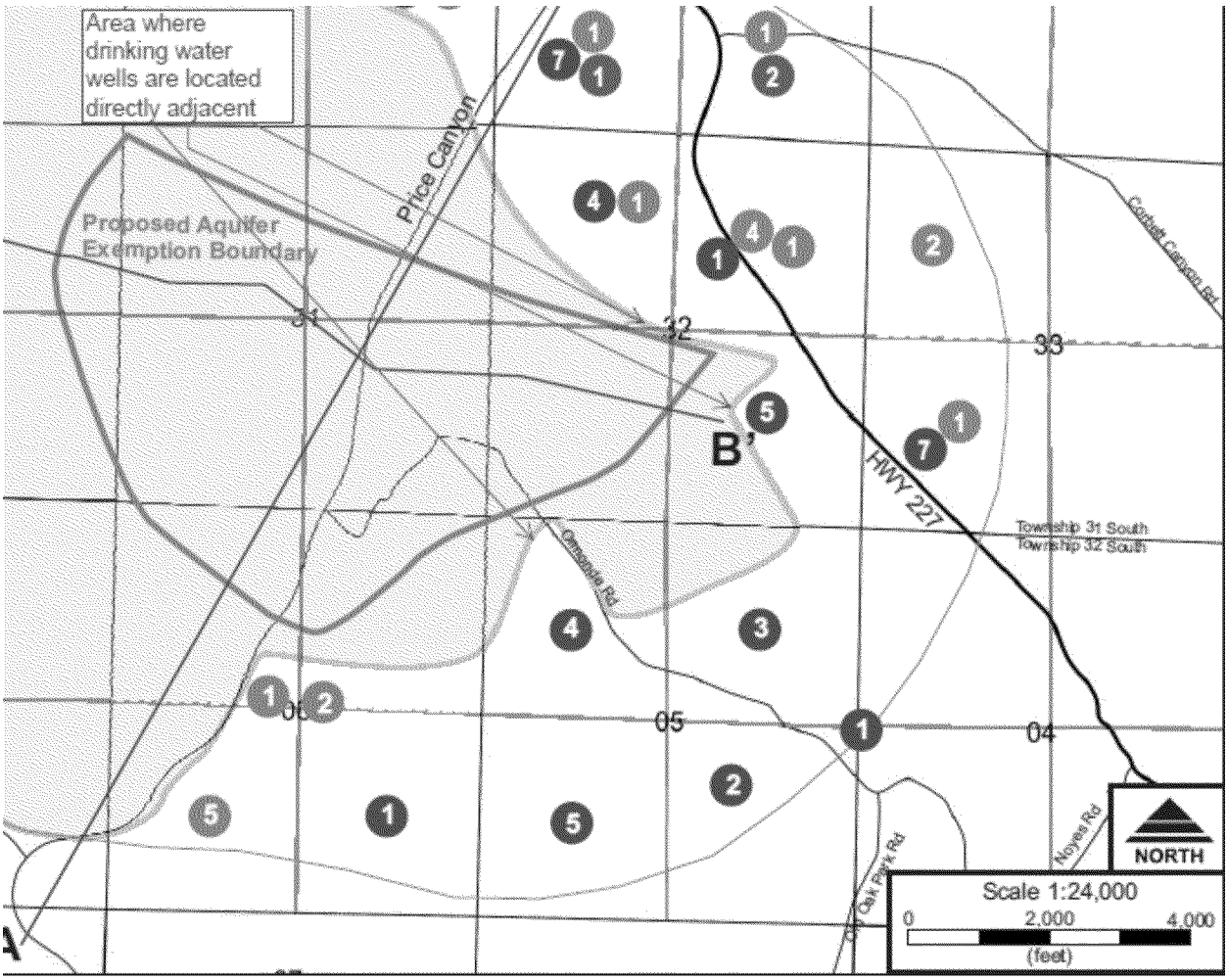
Drinking Water Wells Immediately Adjacent to the Area Proposed for Exemption Need to be Identified and Accurately Mapped

Information included in the Application shows at least 105 drinking water wells to be located within a one-mile radius of the area that has been proposed for exemption.[2] Of these drinking water wells, 24 are known to have been completed in the Edna Member of the Pismo Formation, the same geologic formation and member that is proposed for exemption. (This is a minimum number because well completion data has only been obtained for about half the 105 wells known to be within a one-mile radius of the Project.) The Statement of Basis states "none of the nearby water supply wells are pumping water from the Dollie Sands member of the Pismo Formation" (p. 3) but fails to state that the Dollie Sands are part of the Edna Member of the Pismo Formation, the source of drinking water for the 24 wells adjacent to the exemption area. According to information included in the Application, some wells in the Edna Member produce drinking water from depths up to 510 feet.[3] Injection into the Edna Member in the exemption area occurs at depths as shallow as 600 feet (p. 17).

No map has been prepared for inclusion in the public record for the exemption process or for the Project to accurately show where the 105 drinking water wells are located in an aerial sense. The only maps that have been prepared show well locations in a very general sense. The map, included in the Statement of Basis as Figure 1, and as included below, depicts the 105 drinking water wells on a scale that does not allow for accurate location and uses only dots that are gradational in scale to schematically identify the location of the 105 wells that lie within the one-mile radius of the Project.

Features on the map indicate the immediate proximity of drinking water resources with the proposed aquifer exemption area. The map delineates an "Area with no known water supply wells" that touches upon the northeast corner of the "Proposed aquifer exemption boundary." The juxtaposition of these two boundaries indicates no aerial buffer between the exemption area and the adjacent drinking water. An area on the eastern edge of the "Area with no known water supply wells" (near the B' endpoint of the B-B' cross section and along Ormonde Road) indicates a buffer of just 500 to 1000 feet between the exemption area and the adjacent drinking water.

[2] Review of DWR Well Completion Reports Within One-Mile of the Freeport McMoRan Arroyo Grande Oil Field, June 25, 2015, Cleath-Harris Geologists, Inc., Table A2
[3] Ibid.



Note: Green dots represent wells completed in Pismo Formation aquifers (to include the Edna Member)

The map shows drinking water wells in the Pismo Formation to be approximately located less than two football fields from the exemption area. The Application and the Statement of Basis should identify and disclose the distance of all drinking water wells within a one-mile radius to the exemption area and should confirm the vertical interval (i.e. Geologic Formation and Member) in which the wells are completed.

The Application and Statement of Basis should also evaluate the ability for proposed sentry wells to adequately serve as a warning system for potential contamination. Because of the proximity of the drinking water wells to the exemption area, a detection of contamination in the sentry wells would likely be too late to serve as adequate warning to shut down drinking water wells.

Hydraulic Intercommunication with Exemption area and Drinking Water Wells Needs Evaluation

The exemption application and Statement of Basis claim that the drinking water aquifer and wells are laterally isolated from oil field activities by a fault to the north, the discontinuity of the Edna Member to the south, and a tar seal and loss of permeability to the east and west. The claim that the exemption area is hydraulically isolated from drinking water wells is supported by highly interpretive data. The

application and the Statement of Basis summarize a conceptual model to support this idea but it is a model that has not been evaluated through aquifer tests or through use of numeric groundwater models. Further evaluation of the lateral boundaries is imperative because drinking water wells are located directly adjacent to the exemption area.

The Application and the Statement of Basis attempt to explain that the four sides of the proposed exemption area act as hydraulic barriers or are hydraulically isolated, impeding intercommunication between drinking water. None of the boundary conditions cited by the Applicant are known to create an impermeable hydraulic barrier that would preclude the intercommunication of drinking water aquifers with oil field activities, which include injection and extraction.

1. The Statement of Basis states that there is a facies change to the east of the proposed exempted area and states the Miguelito Member forms the base of a synclinal bowl that represents a low permeability "layer of protection for adjacent drinking water wells." What the Statement of Basis fails to mention is that 24 drinking water wells within the one-mile radius are completed in the Edna Member, and only 6 are completed in the Miguelito Member.[4] The Statement of Basis makes an even greater omission by failing to state that four drinking water wells in Section 32 and seven wells in Section 5, the areas that contain wells nearest to the exemption area, are completed in the Edna Member of the Pismo Formation, the same geologic member and formation that is the subject of the Application.[5] Therefore, the Miguelito Member which underlies the Edna Member, cannot serve as a barrier to hydraulic intercommunication between wells in the exemption area and drinking water wells completed in the Edna Member.

2. The fault that forms the northern boundary of the proposed exemption area is also cited in the Statement of Basis as a barrier to "restrict" (p. 4) flow to/from adjacent drinking water. No tests, including pump tests or aquifer tests, have been performed to validate this idea and how much hydraulic "restriction" is represented by the fault barrier in the area adjacent to drinking water wells. Given that drinking water wells exit in the Edna Member directly across the fault from the proposed exemption area, the idea that the fault "restricts" water flow should be evaluated using an aquifer test where water is added or withdrawn within the exemption area and the hydraulic response in adjacent drinking water wells is measured. Another important line of evaluation would be the use of a numerical groundwater model to simulate conditions of pumping and withdrawal in the exemption area and the hydraulic response in adjacent water wells.

3. Inward hydraulic gradients are also touted as protecting adjacent drinking water, preventing overflow of water in the bowl to adjacent groundwater. However, the inward gradient may induce flow of groundwater across the fault boundary and across any hydraulic boundary that is represented by the tar sands. Any boundary condition cited by the applicant as an impermeable hydraulic seal isolating the oil field with the adjacent drinking water aquifers, must be evaluated in light of the amount of water that is removed from the oil field, a condition known as dewatering. Since approval of the Project, aquifer dewatering has been actively pursued by the

[4] Review of DWR Well Completion Reports Within One-Mile of the Freeport McMoRan Arroyo Grande Oil Field, June 25, 2015, Cleath-Harris Geologists, Inc., Table A2
[5] Ibid.

applicant. Over the past two years, net water extraction from the aquifer has averaged of 18,050 barrels, or 2.33 acre-feet/day. The dewatering lowers hydraulic pressure and creates a "sink," according to the applicant. The impact of this pressure sink on inducing flow from adjacent drinking water resources and across the exemption boundaries has not been evaluated and should be tested using aquifer tests and a numeric model.

4. The tar seal is identified on the east and west sides of the proposed exempted area "to act as a fluid barrier and restrict groundwater flow across these boundaries" (Statement of Basis, p. 4). This statement admits that groundwater flow is restricted but not contained across the tar sands. Since flow is not hydraulically contained, the aquifer that serves as the source of drinking water for adjacent wells is hydraulically connected to the exemption area.

   The very presence of the tar seal is also in doubt. A geologic cross section prepared by the Applicant shows the boundary of the tar seal to be represented by a dashed line (Aquifer Exemption Application, Appendix A 7 a 2, Cross Section B to B'). The use of a dashed line in these cross section means that the existence of the tar seal is uncertain, according to geologic mapping conventions. Therefore, the ability of the tar seal to form a lateral boundary separating Project wells from drinking water wells is unknown

The ability of the four boundary conditions cited in the Application and Statement of Basis to contain water in the exempted area from intercommunication with adjacent wells is unknown. Boundary conditions need to be evaluated through use of a numerical groundwater model to estimate response in the aquifer to Project injection and pumping. Numerical (computer-based) models of groundwater systems are commonly used to simulate the flow of groundwater, including the response of water levels across aquifer boundaries under conditions of injection and pumping. Aquifer tests, where water is removed or added and where response in adjacent wells is measured, are also critical to test the concept of hydraulic barriers.

Conclusions

Approval of the Application be withheld until:

1. Fundamental information on drinking water wells, including locations and cross sectional correlations to injection wells and pumping wells, presented;
2. Boundary conditions are defined through aquifer test and numerical simulations to evaluate if the oil field is isolated from groundwater used for drinking water; and
3. The public has an opportunity to review and comment on this essential information.

Sincerely,

M Hagemann

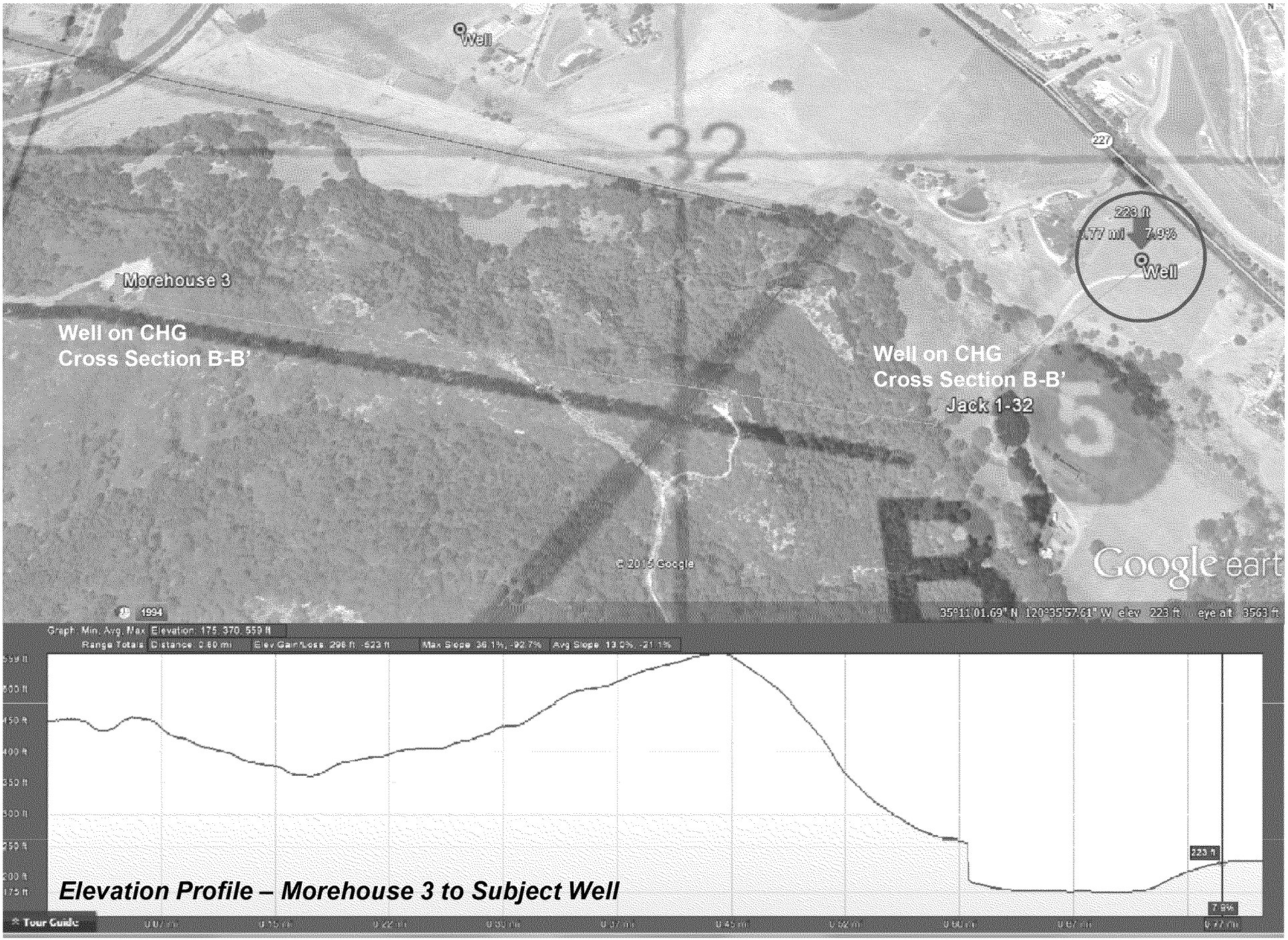
Matt Hagemann, P.G., C.Hg.

Attachment B

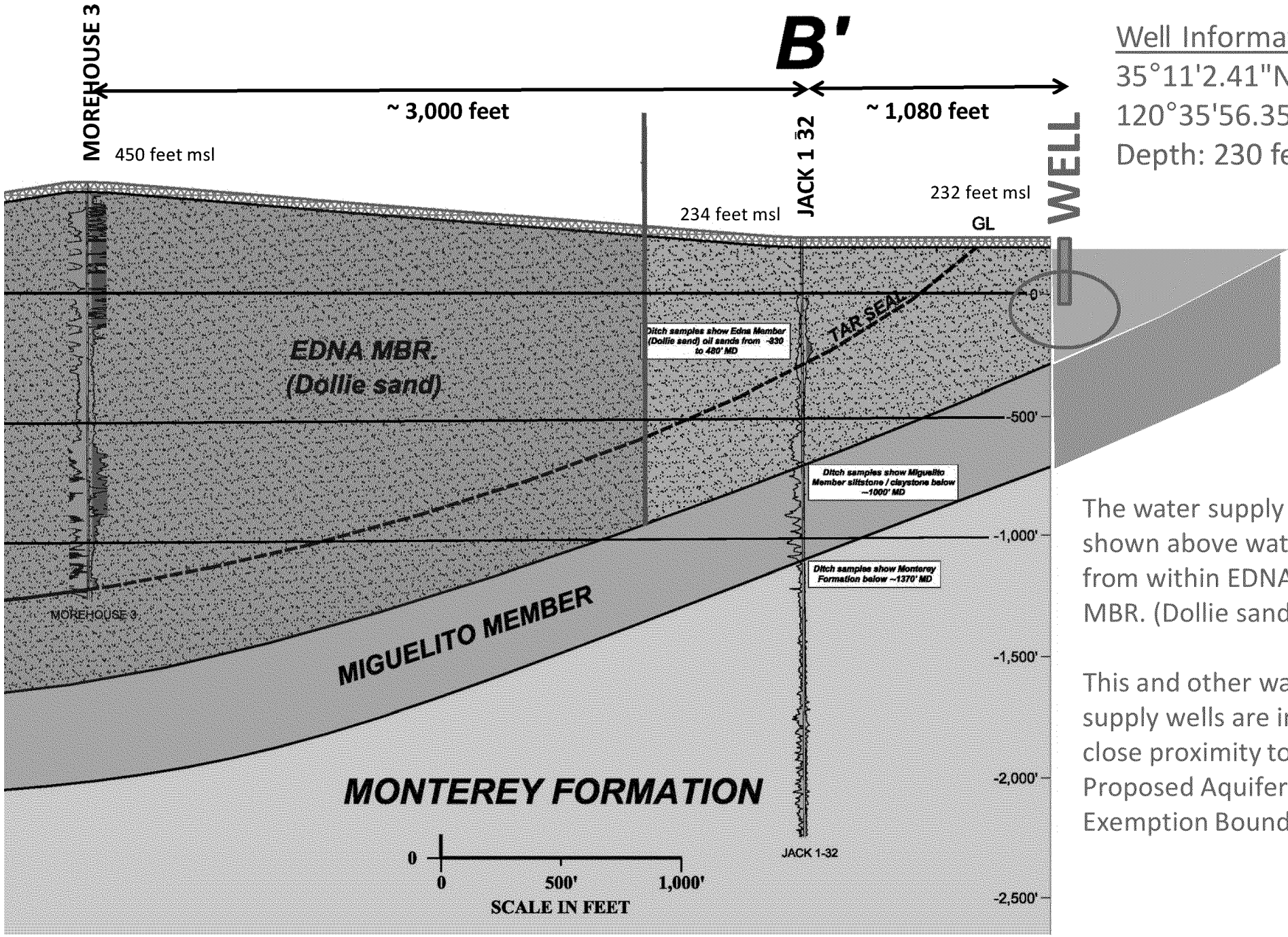
Prepared by Professional Geologist Rob Hesse

Center for Biological Diversity comments on
Arroyo Grande Oil Field
Supplement to Aquifer Exemption Application

Location of Example Water Supply Wells Near Proposed Aquifer Exemption Boundary



Amended Cross Section a Nearby Well to the Proposed Aquifer Exemption Boundary



Well Information
35°11'2.41"N,
120°35'56.35"W
Depth: 230 feet

The water supply well shown above water from within EDNA MBR. (Dollie sand).

This and other water supply wells are in close proximity to the Proposed Aquifer Exemption Boundary.